

What is claimed is:

[Claim 1] 1. A system of active equalization between power supply systems sharing a rechargeable electrical power storage device, applicable to an automotive vehicle, comprising the combination of:

at least a first (1) and a second (2) electrical system, including first (1a) and second (2a) electrical power sources, respectively, for feeding at least one electrical device (3) of said automotive vehicle;

at least one rechargeable electrical power storage device (4) shared by said electrical systems (1, 2);

detection means for detecting at least the current circulating between said first (1) and second (2) electrical systems, said electrical systems (1, 2) and said rechargeable electrical power storage device (4), which is at least one in number, and said electrical systems (1, 2) and said electrical device (3) which is at least one in number, and the voltage in said electrical power sources (1a, 2a) of said first (1) and second (2) electrical systems and in said rechargeable storage device;

at least one switching assembly (5, 6) associated to each of said first (1) and second (2) electrical systems, allowing the rechargeable electrical power storage device (4) to electrically connect with either of said electrical systems (1, 2), or with both, or allowing said electrical systems (1, 2) to connect with each other; and

an electronic system (7) associated to at least said detection means and to said switching assemblies (5, 6), which are at least two in number, and which it controls;

wherein each of said switching assemblies (5, 6) comprises a switching device of a first type (5a, 6a), which is actuated by said electronic system (7) when only one transient electrical connection not exceeding a predetermined time period is required, and a switching device of a second type (5b, 6b), which is actuated by said electronic system (7) when an electrical connection of a duration exceeding that of said predetermined time is required, the electronic system (7) being adapted for determining which elements of the system,

namely the rechargeable electrical power storage device (4), first (1) or second (2) electrical system, need to be connected with each other and for how long.

[Claim 2] 2. A system according to claim 1, characterized in that said switching devices of said first (5a, 6a) and second (5b, 6b) types are connected in parallel, in that the switching device of the first type (5a, 6a) is one-way and is arranged such that it can conduct only from the rechargeable electrical power storage device (4) but not towards it, and in that the switching device of the second type (5b, 6b) is two-way.

[Claim 3] 3. A system according to claim 2, characterized in that the electronic system (7) is adapted for detecting, due to said detection means, that at least one of the electrical systems (1, 2) is incapable of providing by itself the voltage and/or intensity required by the electrical device (3) it feeds, which is at least one in number, detecting that the voltage of said rechargeable electrical power storage device (4) is higher than that of said electrical power source (1a, 2a) of said detected electrical system (1, 2), and adapted for actuating at least one of the switching devices of the first type (5a, 6a) after said detections to connect the rechargeable electrical power storage device (4) with said detected electrical system (1, 2), which is at least one in number, for said predetermined time period.

[Claim 4] 4. A system according to claim 3, characterized in that the electronic system (7) is adapted for actuating at least one of the switching devices (5b, 6b) of the second type to connect the rechargeable electrical power storage device (4) with said detected electrical system (1, 2), which is at least one in number, when after said predetermined time period it detects that it is still incapable of providing by itself the voltage and/or intensity required by the electrical device (3) which it feeds, which is at least one in number.

[Claim 5] 5. A system according to claim 4, characterized in that the switching device of the first type (5a, 6a) is adapted to stop conducting when the switching device of the second type (5b, 6b) conducts.

[Claim 6] 6. A system according to claim 5, characterized in that the electronic system (7) is adapted for sending a disabling signal to the switching device (5a, 6a) of the first type (5a, 6a) when it detects that the switching

device of the second type (5b, 6b) is conducting to prevent accidental actuations of the switching device of the first type (5a, 6a).

[Claim 7] 7. A system according to claim 2, characterized in that the electronic system (7) is adapted for detecting, due to said detection means, that the rechargeable electrical power storage device (4), which is at least one in number, needs to be recharged, and for detecting and finding out which of the electrical systems (1, 2) is more capable of recharging it and accordingly choosing it, and adapted for actuating at least one of the switching devices of the second type (5b, 6b) after said detections to connect said chosen electrical system (1, 2) with the rechargeable electrical power storage device (4).

[Claim 8] 8. A system according to claim 7, characterized in that the electronic system (7) is adapted for sending a disabling signal to the switching device of the first type (5a, 6a) when it detects that the rechargeable electrical power storage device (4) needs to be recharged and before actuating the switching device of the second type (5b, 6b).

[Claim 9] 9. A system according to claim 3, characterized in that the switching device of the first type (5a, 6a) is adapted, when the rechargeable electrical power storage device (4) is electrically connected through said switching device of the first type (5a, 6a) with said electrical system (1, 2) detected as incapable of providing by itself the voltage and/or intensity required by the electrical device (3) which it feeds, to stop conducting when the intensity circulating therethrough tries to change the direction, and/or the voltage at its input decreases to a value equal to or lower than that of the voltage at its output.

[Claim 10] 10. A system according to claim 4, characterized in that the electronic system (7) is adapted, when the rechargeable electrical power storage device (4) is electrically connected through at least one of the switching devices of the second type (5b, 6b), with said electrical system (1, 2) detected as incapable of providing by itself the voltage and/or intensity required by the electrical device (3) which it feeds, for deactivating said switching device of the second type (5b, 6b) when it detects that the intensity circulating between the rechargeable electrical power storage device (4) and

the detected electrical system (1, 2) changes the direction, the resultant being a current entering into the rechargeable electrical power storage device (4).

[Claim 11] 11. A system according to claim 9, characterized in that the electronic system (7) is adapted for sending a disabling signal to said switching device of the first type (5a, 6a) which has stopped conducting when, due to the fact that the voltage of the detected electrical system (1, 2) has increased to above the voltage of the rechargeable electrical power storage device (4) and has again decreased a determined number of times, this device has again started conducting and stopped conducting said determined number of times.

[Claim 12] 12. A system according to claim 9, characterized in that the electronic system (7) is adapted for sending a disabling signal to said switching device of the first type (5a, 6a) which has stopped conducting immediately after the latter has stopped conducting.

[Claim 13] 13. A system according to claim 7, characterized in that the electronic system (7) is adapted for sending an alarm signal representative of an overload when it detects, due to the detection means, that the rechargeable electrical power storage device (4) needs to be recharged, and that neither of the first (1) and second (2) electrical systems is capable of recharging it.

[Claim 14] 14. A system according to claim 7, characterized in that the electronic system (7) is adapted for furthermore detecting that another one of the electrical systems (1, 2) is incapable of providing by itself the voltage and/or intensity required by the electrical device (3) which it feeds, and that at least said electrical system (1, 2) chosen for recharging the rechargeable electrical power storage device (4) is also capable of helping said other electrical system (1, 2) feed its respective electrical device (3), and adapted for also actuating the switching device of the second type (5b, 6b) associated to said other electrical system (1, 2) after said detections to connect both electrical systems (1, 2) with each other and with the rechargeable electrical power storage device (4).

[Claim 15] 15. A system according to claim 1, characterized in that said switching device of the first type (5a, 6a) is a power semiconductor device,

such as a thyristor, and in that said switching device of the second type (5b, 6b) is a power switch, such as a bi-stable relay.

[Claim 16] 16. A system according to claim 1, characterized in that the electronic system (7) comprises at least one microprocessor (8) and a series of associated electronic and logic circuits (CI).

[Claim 17] 17. A system according to claim 1, characterized in that the rechargeable electrical power storage device (4) is a spare battery (4).

[Claim 18] 18. A method of active equalization between power supply systems sharing a rechargeable electrical power storage device, applicable to an automotive vehicle, said power supply systems including at least a first (1) and a second (2) electrical system, including first (1a) and second (2a) electrical power sources, respectively, to feed at least one electrical device (3) of said automotive vehicle, characterized in that it comprises:

- a) detecting that at least one of said electrical systems (1, 2), which are at least two in number, is incapable of providing by itself the voltage and/or intensity required by at least one electrical device (3) which it feeds;
- b) detecting that said rechargeable electrical power storage device (4) has a voltage higher than that of said electrical power source (1a, 2a) of said detected electrical system (1, 2);
- c) actuating a switching device of a first type(5a, 6a), to electrically connect said rechargeable electrical power storage device (4) with said electrical system (1, 2) detected for a predetermined time period for helping the detected electrical system (1, 2) feed said electrical device (3); and
- d) actuating a switching device of a second type (5b, 6b) to electrically connect said rechargeable electrical power storage device (4) with said electrical system (1, 2) detected for a longer time period than said predetermined time period, if after said predetermined time period the detected electrical system (1, 2) is still incapable of providing by itself the voltage and/or intensity required by the electrical device (3) which it feeds, to continue helping the detected electrical system (1, 2) feed said electrical device (3).

[Claim 19] 19. A method according to claim 18, characterized in that it furthermore comprises:

e) detecting that the voltage in said rechargeable electrical power storage device (4) has decreased to below that of the electrical power source (1a, 2a), of said electrical system (1, 2) detected as incapable of providing by itself the voltage and/or intensity required by the electrical device (3) which it feeds;
f) detecting that one of said electrical systems (1, 2) is capable of recharging said rechargeable electrical power storage device (4); and
g) actuating one of said switching devices (5b, 6b) of a second type of said electrical system (1, 2) detected in f) to electrically connect it with the rechargeable electrical power storage device (4) in a direction opposite to that of said steps c) and d), and recharge it.

[Claim 20] 20. A method according to claim 19, characterized in that it furthermore comprises:

h) detecting that another one of said electrical systems (1, 2) is incapable of providing by itself the voltage and/or intensity required by the electrical device (3) which it feeds;
i) detecting that said electrical system (1, 2) detected in f) is capable of helping said other electrical system (1, 2) detected in h) feed the electrical device (3) which it feeds, in addition to recharging the rechargeable electrical power storage device (4); and
j) actuating, in addition to said switching device actuated in g), one of said switching devices of a second type (5b, 6b) of said other electrical system (1, 2) to electrically connect the electrical system (1, 2) detected in f) with the rechargeable electrical power storage device (4) to recharge it, and with the electrical system (1, 2) detected in h) for helping it feed the electrical device (3) which it feeds.